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ABSTRACT

The opportunity for U.S. students to learn algebra and geometry in the eighth grade was studied by looking at exposure to instruction using teacher reports of content coverage from a subset of 296 classrooms participating in the Third International Mathematics and Science Study. Classrooms were classified according to the ethnic composition of students and the socioeconomic status of the classroom. Few differences were found between low-socioeconomic status White/Asian and minority classrooms across all algebra and geometry related topics, but stark differences were seen between high socioeconomic status white/Asian and minority classrooms. Exposure to algebra and geometry topics varied across classrooms, with the practice of tracking a likely explanation for differences in students' opportunity to learn. It was clear that fewer high-socioeconomic status minority classrooms than high socioeconomic White/Asian classrooms covered a more rigorous curriculum. (SLD)

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Objective and Purpose

The current study investigates the opportunity for U.S. students to learn algebra and geometry in the eighth grade by looking at exposure to instruction. Teacher reports of content coverage are used as a direct measure of exposure to instruction on algebra- and geometry-related topics. Both race/ethnicity and socioeconomic status are considered.

Introduction

Opportunity to learn (OTL) covers many factors, including teacher training, rigorous standards, student exposure to instruction, student readiness, student motivation, and adequate physical facilities (Noddings, 1997). Each of these factors deserves individual attention, particularly if opportunities are skewed across racial and ethnic lines.

Research suggests that African-American students may not be exposed to algebra and geometry to the same degree as their white peers. In one recent study, African-American students in Grade 8 perceived themselves as having significantly less exposure to instruction in the areas of algebra and geometry than European-American students have (Kim, 1998).

While exposure to mathematics instruction is only one piece of OTL, it is a critical piece. A National Assessment of Education Progress (NAEP) report has shown that the number of mathematics courses high school seniors take is associated with mathematics achievement (Reynolds & Walberg, 1992). When considering specific content, students cannot be expected to learn material that has not been taught to them.

Method

The study uses teacher data from the Third International Mathematics and Science Study (TIMSS), administered in 1995, to examine the opportunity for eighth-grade students to learn algebra and geometry. For the study, "opportunity" is limited to teacher report of topic coverage.

Design

Eighth-grade classrooms were divided into four groups based on the ethnic composition of students and socioeconomic status (SES) of the classroom: high-SES minority, high-SES white/Asian, low-SES minority, and low-SES white/Asian). For ethnicity, white and Asian-American students were clustered into one group; black, Hispanic, Native-American, and other students were clustered into another group. These groups were formed on the basis of national trends in academic achievement; white and Asian-American students usually outperform students of color.

For each of eight topics (see Figure 2), the study reports the percentage of classrooms in the four groups listed above that cover the topic before or during Grade 8.

Participants

The study focuses on a subset of 296 U.S. eighth-grade mathematics classrooms drawn from the U.S. TIMSS sample based on the racial composition of the classrooms (defined below). The number of classrooms, the number of students, and the average size of classrooms are presented in Figure 1 for all classrooms and across the four ethnic/SES groups.

Figure 1. Characteristics of Grade 8 U. S. Mathematics Classrooms Across Socioeconomic Status and Ethnicity

	N Classrooms	N Students	Average Classroom Size
High per capita income			
60% or more of students are minority	27	509	19
60% of more of students are white/Asian	127	2724	21
Low per capita income			
60% or more of students are minority	45	890	20
60% of more of students are white/Asian	97	1872	19
Total	296	5995	20

Instruments

The study uses TIMSS teacher surveys to track when algebra and geometry topics were covered. Topics were either covered:

- Before Grade 8 (covered earlier)
- Before and during Grade 8 (reinforced)
- For the first time in Grade 8 (new information)
- Not at all before or during Grade 8 (not taught)

The study also uses data from the 1990 census on per capita income in the school district to determine socioeconomic status[1]. These data are presented at the classroom level. In a few cases, the study includes more than one classroom from the same district.

In the study, racial/ethnic composition of classrooms is based on student report of ethnicity on the TIMSS student survey.

Analysis

This descriptive study illustrates the percentage of classrooms that cover algebra and geometry topics before or during Grade 8. These classrooms are divided into four categories based on the socioeconomic status and ethnicity dimensions defined above.

[1] NCREL received from the National Center for Education Statistics restricted-use data that allowed us to match TIMSS and census data.

Results

Figure 2 illustrates that few differences were found between low-SES white/Asian and minority classrooms across all algebra- and geometry-related topics. For both groups, topics were introduced in the eighth grade as new information the majority of the time. For another 10 to 20 percent of these groups, the topics were reinforced. Finally, less than 5 percent of the classrooms had covered the topics before eighth grade.

On the other hand, stark differences are illustrated between high-SES white/Asian and minority classrooms. For most topics, far more white/Asian classrooms than minority classrooms covered the topics before eighth grade. Yet, in 25 to 100 percent of the high-SES minority classrooms, these topics were either introduced as new material or were not taught at all.

Discussion

Exposure to algebra and geometry topics varied across classrooms. Differential exposure to rigorous mathematics content in Grade 8 is not unusual in the U.S. The practice of tracking—systematically placing students into classrooms with different curricula—is a likely explanation for differences in students' OTL.

Unfortunately, the practice of tracking was not queried on the TIMSS survey and details are unavailable. Yet it can be inferred that classrooms that covered algebra and geometry before Grade 8 were advanced tracks.

Given this inference, it is of even greater concern to note that race and SES seem to define tracks. Clearly fewer high-SES minority classrooms than high-SES white/Asian classrooms covered a more rigorous curriculum. This finding is particularly true among economically advantaged classrooms. Future research should attempt to link OTL in student demographic groups to tracking policies in schools. From there, research can explore the impact of these practices on student achievement.

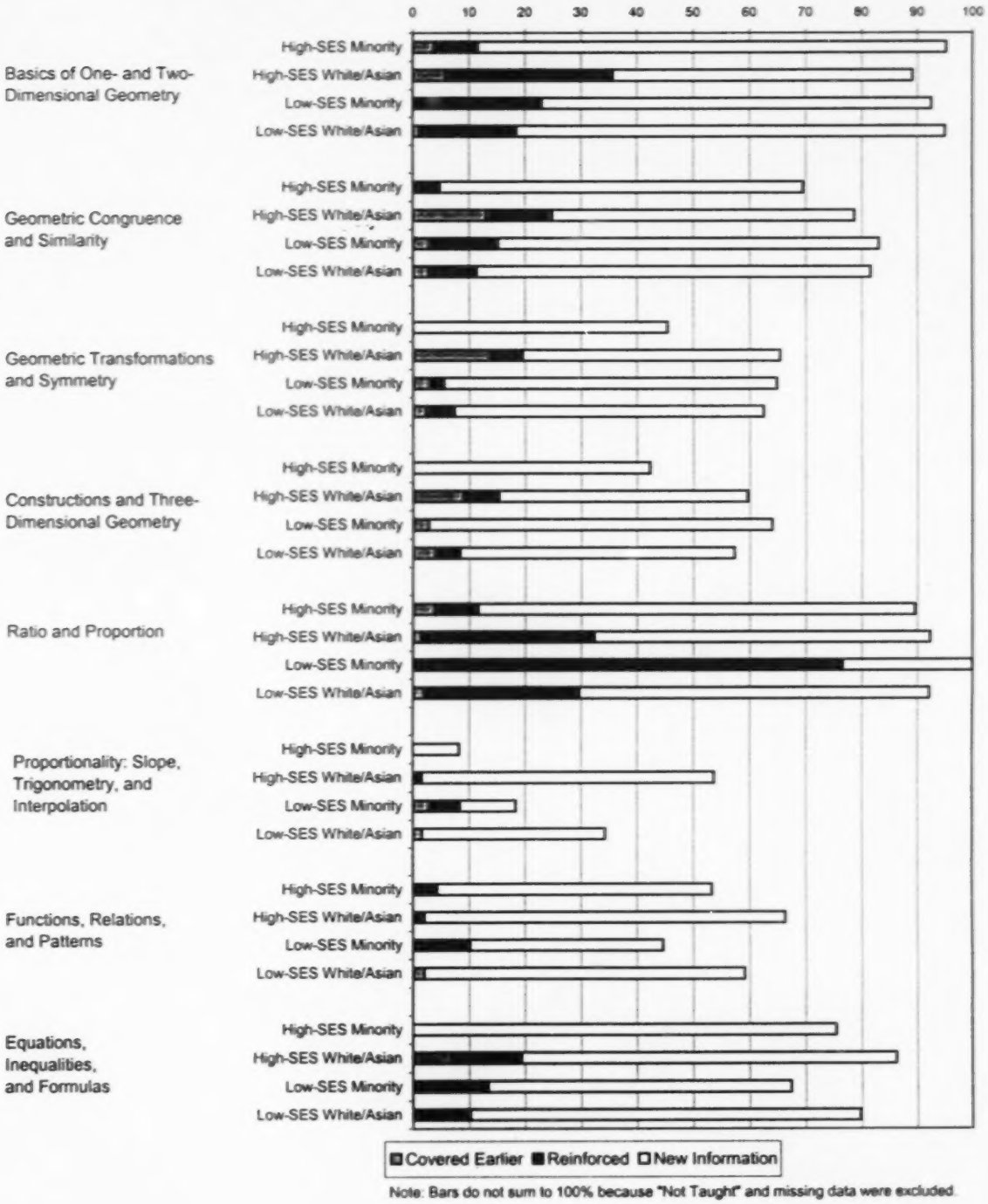
References

Kim, S. (1998). Racial differences in eighth-grade mathematics: Achievement and opportunity to learn. *The Clearing House, 71*(3), 175-178.

Noddings, N. (November, 1997). Thinking about standards. *Phi Delta Kappan, 79*(3), 184-189.

Reynolds, A., & Walberg, H. (1992). A structural model of high school mathematics outcomes. *Journal of Educational Research, 85,* 150-58.

Figure 2. Exposure to Algebra and Geometry Instruction: Percentage of Grade 8 U.S. Classrooms Across Race of Student and Socioeconomic Status of School



Note: Bars do not sum to 100% because "Not Taught" and missing data were excluded.